useful. It is well not to give the student too many of them or he will become confused.

Here are some conclusions that may be derived from the equations, (1) and (2).

From (1), let $F = W$, the case of a body falling at latitude 45° at the sea level; then $V = gT$. If T also $= 1$, then $V = g$, that is the velocity at the end of 1 second is g.

In the equation $V = gT$ substitute for T its value $2S/V$ and we have $V = 2gS/V$, whence $V^2 = 2gS$. In the case of falling bodies, the height of fall H is usually substituted for S, and we obtain $V = \sqrt{2gH}$ (3).

Equation (2) with $F = W$ gives $V = \frac{1}{2}gT^2$.

From (1), by transposition we may obtain $FT = W \times V/g$ (4). The product FT is sometimes called impulse, and to the expression $W \times V/g$ is given the term momentum. It is usually written W/gV, but there is no reason why, except that it is customary, and it has been found convenient to use the letter M instead of W/g, so that the equation becomes

$$FT = MV \qquad (5)$$

Impulse = Momentum

In (4) we may substitute for T its value in terms of S and V above given, viz., $T = 2S/V$ and obtain $F2S/V = MV$; whence $FS = \frac{1}{2}MV^2$ (6). The product FS is called work, and the expression $\frac{1}{2}MV^2$ kinetic energy, whence work expended = kinetic energy.

Acceleration.—The quotient V/T is called the acceleration. It may be defined at the rate of increase of velocity, the word rate, unless otherwise stated, always meaning the rate with respect to time, or "time-rate." In the problem under consideration, the action of a force in a body free to move, with no retardation by friction, the acceleration is a constant, $V/T = A$. The quantity g is commonly called the acceleration due to gravity, but it also may be considered either as an abstract figure, the constant g in equation (1), or as the velocity acquired at the end of 1 second by a falling body, or as the distance a body would travel in 1 second at that same velocity if the force ceased to act and the velocity remained constant.

Equation (6) then may be written

$$F = MA \qquad (7)$$

Force = M times the acceleration.

If a given particle [body] is acted on at two different times by two forces F and F', and if A and A' are the corresponding accelerations, then $\frac{F = MA}{F' = MA'}$ whence $F/F' = A/A'$. (8)

Equation (7) is called the fundamental equation by Professor Hoskins, while equation (8) is called fundamental by Professor Huntington, but it is shown above that they are derived from the more fundamental equation $V = FTg/W$.

Summary.—Take equation (1), $V = FTg/W$ (1). Substitute $2S/T$ for V, $S = FT^2g/2W$ (2).

Take $F = W$, then $S = \frac{1}{2}gT^2$,

and $V = \sqrt{2gH}$ (3)

From (1) by transposition $FT = WV/g$ (4)

Substitute M for W/g, $FT = MV$ (5).

In (5) substitute $2S/V$ for T,

$$FS = \tfrac{1}{2}MV^2 \qquad (6)$$

In (5) substitute A for V/T, $F = MA$ (7)

Apply (7) to the case of two forces acting at different times on the same body

$$F/F' = A/A' \qquad (8)$$

In this treatment the ambiguous words "weight" and "mass" have purposely been omitted.

If there is any easier way of "making the student understand the effect which a force produces when it acts on a material particle" than to have him study the above discussion and solve examples by its aid, it is very important that it should be found and incorporated in the text-books.

Wm. Kent

A COURSE IN AGRICULTURE FOR NON-TECHNICAL COLLEGES

That there is an interest in agriculture as a subject of study in colleges or higher institutions in addition to that met by the state agricultural colleges, is manifested by the introduction a few years ago into the curriculum, in certain institutions (*e. g.*, Syracuse and Miami Universities) of several subjects associated with the work of the land-grant colleges. Further evidence is shown in the

preparation by one of the professors of a text on agricultural education which is regarded as well toward the head of the list upon that subject. But there seems to be still a field for educational work in agriculture, apparently not touched by any of the current courses, by which the subject matter of botany, zoology, geology and meteorology can be correlated with history through the common ground of agriculture.

The recent article upon agricultural botany, by Dr. Copeland, in SCIENCE, September 18, has suggested some details of such possible correlation in addition to a general plan already in mind. The scope of the course in mind is just the reverse of the work as ordinarily catalogued as a "Course in Agriculture" in the state colleges. Such courses take the general subject, agriculture, and divide it into its component parts, assigning portions to agronomy, to horticulture, to animal husbandry, soils, farm management and the other familiar departments. The other plan would take the work in the botanical laboratory and would show where it is of common application in the regular work of the farm; and in zoology, why the domestic animals are so useful to man through their anatomy and physiology, in place of merely noting their places as mammals in taxonomic scheme. It would show that the development of the technique of agriculture has been the companion, if not the guide, to advancing civilization through ethnology and anthropology to modern history, commercial and industrial.

This is an ambitious aim and would require much careful selection of material, before it could be regarded as definitely outlined. The final form would be an adjustment of the ideas of several rather than the dictum of an individual, as has been the case with college-entrance requirements in the sciences, although no official sanction, outside the several institutions which might offer the course, would be called for. As here outlined, the principal work of the course would be cared for by the regular staff of instructors in botany, zoology, geology, etc., the specialists in agronomy, live-stock or soils being left with their respective subjects in the technical school. Under such regular teachers, however, those details in their course which relate to agriculture in any manner are to be brought out and made the peg upon which to hang the several facts of structure, behavior or adaptation observed.

The field as a whole may be divided into four sections, as follows:

1. *Soil.*—The basis of agricultural activity. Origin of soils; types of soil; properties of different soils; soil biology; soil management.

2. *Plants.*—The factory of agricultural products. Seeds; growth; nutrition; reproduction; weeds and diseases; phytogeography; agricultural ecology.

3. *Animals.*—The product of agricultural factory. Nutrition; anatomy; physiology; breeds; uses; predacious and beneficial species.

4. *Man.*—The controlling factor in agriculture. Races, civilization, colonization; commerce; rural and urban; raw materials and manufactures.

In attempting to assign to these topics their places in the four-year course, it must be remembered that it is not practical agriculture, but fundamental agriculture, that is in mind; it is not an attempt to make farmers, but to show how the farmer gets the results he does from certain methods of procedure, and why he is using those methods instead of some others, in a historical and economic, rather than technical and special study. Thus under the subject of soils, the danger of severe washing of fall-plowed fields in the south would be contrasted with the beneficial effects of the frost work on similarly treated fields in the colder states. Through the aid of the departments or instructors in bacteriology and mycology, relation between soil bacteria, root-infesting fungi and other organisms could be shown as scientific reasons behind the observed benefits of crop rotation, thus connecting the work on soils with that on crop plants. In the consideration of plants, the fact that upon green plants all animal life depends is the keynote, with details added discussing the parts of such plants utilized in particular cases, thus connecting directly with the study of those animals which make direct use of plant tissues for food. Under animals, the adaptation of the teeth to hard-stemmed forage

plants and the ease with which such crops are raised, should be brought out as important details in the usefulness of horses and cattle, as well as their anatomical adaptation to the work of pulling or carrying loads, and their physiological adaptations for meat and milk production.

The treatment of man as outlined would involve as much of the advanced sciences of anthropology and ethnology as one had time for; would naturally involve ancient history, in connection with grain commerce of Rome and her colonies; would take up the development of agricultural communities through the feudal system to the modern village of tenant farmers, and the rise of the freeholders, especially in the new settlements. The relation of established feast days (*e. g.*, Feast of First Fruits) of the ancient tribes, to events of the agricultural year would introduce the religious side of man, and the importance of conserving the produce of his labor, would serve to connect the ideas of property, ownership, wealth, capital and law.

The simpler relations would naturally be assigned to the earlier years of the course. Thus the subjects relating to plant life, in their fundamental details could be given in the sophomore year, supplementing the freshman work in botany; some work would likely be well retained to a later period. Soil work should follow the first year's work in chemistry and in physics, as the general properties of soils are in accordance with the principles learned in those subjects. The study of animals in relation to agriculture would be a good junior subject, as the additional year of work would make it the easier for the student to follow the course, and to grasp the essential points of structure, behavior, conditions of existence among wild and domestic animals, and similar details after he has had the less complex relationships among plants brought out in the sophomore work.

The study of the relation of man to agriculture, as suggested, should come in the senior year, in order that the work in history, economics, engineering and science may be available for use to aid in the development of the course by each man in the class bringing to it as broad a basis of work as possible. The topics introduced at this stage might easily serve as the basis of further study by the few specially interested along the lines of colonial, economic or industrial development. Frequent assignments of readings would be necessary, as the material is scattered and must be brought together under the new viewpoint.

Some suggestions have been found in several text-books on agriculture, agricultural education, farm management and similar topics, more or less along the lines here suggested, but in most cases, the discussion was from the standpoint of technical agriculture, as would be expected. Particular chapters could, however, be selected from a number of such books, to be used as collateral reading by either of the four college classes, suitably supplemented by lectures presenting the desired viewpoint, and developing the central theme. This may be briefly stated as follows: Agriculture as the oldest industrial occupation of man is the basis of all his later achievements, and supports him in his highest attainments. The course might be designated as one in "The development and scope of agriculture" and could be a lecture course supplemented by specified laboratory and class work in the several departments involved. The course might also be developed as a series of short courses, something on the plan of the "summer school" work, correlated by a carefully prepared syllabus or outline, each teacher selecting those phases of the work most closely related to agriculture in its broadest sense, and emphasizing the relation of his subject to the general topic.

Frederick H. Blodgett

SCIENTIFIC BOOKS

Psychology: General and Applied. By Hugo Münsterberg. New York and London, Appleton, 1914. Pp. xiv + 487.

Professor Münsterberg's latest work breaks away from the traditional presentation of psychology in many respects. The most novel features are the author's treatment of mental data from the teleological standpoint and the